

CLAIMS

- 1 1. A system for imaging of a sample, comprising:
 - 2 a plurality of detectors which are each focussed at a respective focal plane in a
 - 3 sample volume; and
 - 4 light selection optics positioned between the plurality of detectors and the
 - 5 sample volume, the light selection optics for transmitting to the detectors a portion of
 - 6 light originating at the respective focal planes while screening out light which
 - 7 originates from outside of the respective focal planes.
- 1 2. The system of claim 1, wherein the light selection optics includes a plurality
- 2 of ON regions and OFF regions, the ON regions transmitting the light from the
- 3 respective focal planes and the OFF regions blocking the light from the respective
- 4 focal planes.
- 1 3. The system of claim 1, wherein a pulse laser provides multiphoton
- 2 fluorescence.
- 1 4. The system of claim 1, wherein the ON regions can be controllably changed to
- 2 OFF regions and the OFF regions can be controllably changed to ON regions.
- 1 5. The system of claim 1, wherein the light selection optics provide each detector
- 2 with a degree of confocality.
- 1 6. The system of claim 4, wherein a pattern of ON and OFF regions controls the
- 2 degree of confocality provided to the view from each detector.
- 1 7. The system of claim 4, wherein the light selection optics concurrently provide
- 2 the degree of confocality to each of the detectors in the plurality of detectors.

1 8. The system of claim 1, wherein the light selection optics includes a plurality
2 of mirrors which can occupy an ON position or an OFF position, the ON regions
3 transmitting the light from the respective focal planes and the OFF regions blocking
4 the light from the respective focal planes.

1 9. The system of claim 1, wherein each detector is focussed on a different region
2 of the sample and the light selection optics selects the portion of each region which is
3 viewed by the detector focussed on the region.

1 10. The system of claim 1, further comprising:
2 focus differentiation optics which causes each detector to be focussed at the
3 different depths within the sample.

1 11. The system of claim 9 wherein the focus differentiation optics can be adjusted
2 so as to alter where a detector is focussed within the sample.

1 12. The system of claim 9, wherein each detector is positioned equidistant from
2 the focus differentiation optics.

1 13. The system of claim 11, wherein the material of the focus differentiation
2 optics has at least one first side and a plurality of second sides, each second side being
3 positioned at a different distance from the at least one first side.

1 14. The system of claim 13, wherein each second side is substantially parallel to
2 one of the at least one first side.

1 15. The system of claim 1, further comprising:
2 a light source and optics configured to illuminate the sample with a light
3 which causes a dye in the sample to fluoresce.

- 1 16. The system of claim 1, further comprising:
 - 2 a light source and optics configured to illuminate the sample and transfer
 - 3 reflected light from the sample to the detectors.
- 1 17. The system of claim 1, further comprising:
 - 2 relay optics position between the light selection optics and the detectors.
- 1 18. The system of claim 1, further comprising:
 - 2 magnification adjustment optics positioned between the detectors and the light
 - 3 selection optics, the magnification adjustment optics compensating for differences in
 - 4 magnification in the view from each detector.
- 1 19. The system of claim 1, further comprising:
 - 2 a sample fixture for holding the sample being viewed, the sample fixture
 - 3 configured to scan the sample relative to the light selection optics.
- 1 20. The system of claim 1, further comprising:
 - 2 a processing system for processing and display of outputs of the detectors
 - 3 simultaneously as a three dimensional image.
- 1 21. The system of claim 1, wherein each detector includes an area array sensor.
- 1 22. The system of claim 21 wherein each detector is electrically controlled to
 - 2 produce time-delay-and-integration.
- 1 23. The system of claim 1, wherein the selection optics increase the ratio of
 - 2 intensity of light received at the detector which originates from the associated focal
 - 3 plane to the intensity of light received at the detector which originates from outside
 - 4 the associated focal plane.

- 1 24. A method for imaging a sample, comprising:
 - 2 providing a plurality of detectors;
 - 3 focussing each of the detectors at a respective focal plane within a sample
 - 4 volume; and
 - 5 transmitting to the detectors a portion of light originating at the respective
 - 6 focal planes while screening out light which originates from outside of the respective
 - 7 focal planes.
- 1 25. The method of claim 24, further comprising:
 - 2 moving the sample so at least a portion of the sample is scanned by the
 - 3 detectors.
- 1 26. The method of claim 24, further comprising:
 - 2 providing output from each detector to a processing, display and storage
 - 3 system.
- 1 27. The method of claim 24, further comprising:
 - 2 filtering the output from each detector to provide 3D filtered output.
- 1 28. The method of claim 27 further comprising utilizing the processing system to
 - 2 segment the 3D image into 3D objects.
- 1 29. The method of claim 28 utilizing the processing system to classify the objects
 - 2 into types of objects based on measurements processed from the 3D object segments.